Amendments to the Claims

This listing of claims replaces all prior versions and listings of claims in the application. Please amend the claims as follows:

1. (Currently Amended) A method for predicting a value of a property of processed material, the method comprising ~~the steps of~~:

   (a) providing a process description comprising at least one governing equation;

   (b) obtaining a characterization of a flow of a material ~~using~~ based, at least in part, on the process description using one or more processors;

   (c) obtaining a morphological characterization of the material ~~using~~ based, at least in part, on the characterization of the flow of the material using the one or more processors, wherein step (c) comprises obtaining the morphological characterization using a description of crystallization kinetics of the material, wherein the description of crystallization kinetics of the material comprises an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term; and

   (d) predicting a value of a property of the material ~~using~~ based, at least in part, on the morphological characterization using the one or more processors, wherein step (d) comprises predicting a viscosity that is used in the process description in step (b) to characterize flow.

2. (Original) The method of claim 1, wherein the process description comprises a representation of an injection molding process.

3. (Original) The method of claim 1, wherein the process description comprises a representation of at least one member of the group consisting of an extrusion process, a blow molding process, a vacuum forming process, a spinning process, and a curing process.

4. (Original) The method of claim 1, wherein the at least one governing equation comprises conservation of mass, conservation of momentum, and conservation of energy equations.

5. (Original) The method of claim 1, wherein step (d) comprises predicting an elastic modulus of the material.

6. (Original) The method of claim 5, wherein the elastic modulus is one of the group consisting of a longitudinal Young's modulus, a transverse Young's modulus, an in-plane shear modulus, an out-plane shear modulus, and a plane-strain bulk modulus.

7. (Original) The method of claim 1, wherein step (d) comprises predicting a complex modulus of the material.

8. (Original) The method of claim 7, further comprising the step of:
   (e) predicting a value of a property of the material from the complex modulus.

9. (Original) The method of claim 1, wherein step (d) comprises predicting at least one member of the group consisting of a mechanical property, a thermal property, and an optical property.

10. (Original) The method of claim 1, wherein step (d) comprises predicting at least one of a thermal expansion coefficient, a thermal conductivity, a bulk modulus, and a sound speed.

11. (Previously Presented) The method of claim 1, wherein step (d) comprises predicting at least one of clarity, opaqueness, surface gloss, color variation, dynamic viscosity, birefringence, and refractive index.

12. (Original) The method of claim 1, wherein step (d) comprises predicting at least one

component of a stress tensor.

13. (Original) The method of claim 12, wherein the stress tensor comprises a measure of flow-induced stress.

14. (Original) The method of claim 1, wherein the morphological characterization comprises at least one component of a conformation tensor.

15. (Original) The method of claim 1, wherein the morphological characterization comprises at least one component of an orientation tensor.

16. (Original) The method of claim 1, wherein the morphological characterization comprises a measure of crystallinity.

17. (Original) The method of claim 16, wherein the measure of crystallinity is a measure of relative crystallinity.

18-21. (Canceled)

22. (Original) The method of claim 1, wherein step (c) comprises obtaining the morphological characterization using a two-phase description of the material.

23. (Original) The method of claim 22, wherein the two-phase description comprises at least one of a crystallization kinetics model, an amorphous phase model, and a semi-crystalline phase model.

24. (Original) The method of claim 22, wherein the two-phase description comprises a crystallization kinetics model, an amorphous phase model, and a semi-crystalline phase model.

25. (Original) The method of claim 22, wherein the two-phase description comprises a viscoelastic constitutive equation that describes an amorphous phase.

26. (Previously Presented) The method of claim 25, wherein the viscoelastic constitutive equation comprises a finite extensible non-linear elastic model with a Peterlin closure approximation dumbbell model.

27. (Original) The method of claim 25, wherein the viscoelastic constitutive equation comprises at least one of an extended POM-POM model and a POM-POM model.

28. (Original) The method of claim 25, wherein the viscoelastic constitutive equation comprises at least one of a Giesekus model and a Phan-Thien Tanner model.

29. (Original) The method of claim 22, wherein the two-phase constitutive description comprises a rigid dumbbell model that describes a semi-crystalline phase.

30. (Original) The method of claim 1, further comprising the step of:

(e) performing a structural analysis of a product made from the processed material using the value of the property of the material.

31. (Original) The method of claim 30, wherein step (e) comprises predicting warpage of the product.

32. (Original) The method of claim 30, wherein step (e) comprises predicting shrinkage of the product.

33. (Original) The method of claim 30, wherein step (e) comprises predicting how the product

reacts to a force.

34. (Original) The method of claim 30, wherein step (e) comprises predicting at least one of the group consisting of crack propagation, creep, and wear.

35. (Original) The method of claim 30, wherein step (e) comprises predicting at least one member of the group consisting of impact strength, mode of failure, mode of ductile failure, mode of brittle failure, failure stress, failure strain, failure modulus, failure flexural modulus, failure tensile modulus, stiffness, maximum loading, and burst strength.

36. (Original) The method of claim 1, wherein obtaining the flow characterization comprises using a dual domain solution method.

37. (Original) The method of claim 1, wherein obtaining the flow characterization comprises using a hybrid solution method.

38. (Original) The method of claim 1, wherein step (b) is performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a).

39. (Original) The method of claim 1, wherein steps (b) and (c) are performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a).

40. (Original) The method of claim 1, wherein steps (b), (c), and (d) are performed after each of a plurality of time steps associated with a solution of the at least one governing equation in step (a).

41. (Original) The method of claim 1, wherein step (c) comprises performing one or more

crystallization experiments to determine one or more parameters used to obtain the morphological characterization.

42. (Original) The method of claim 1, wherein step (c) comprises performing one or more crystallization experiments to determine a crystal growth rate of the material under quiescent conditions.

43. (Original) The method of claim 1, wherein step (c) comprises performing one or more crystallization experiments to determine a half-crystallization time.

44. (Original) The method of claim 1, wherein step (c) comprises performing one or more experiments to determine at least one of a relaxation spectrum and a time-temperature shift factor.

45. (Currently Amended) A method for performing a structural analysis of a manufactured part, the method comprising ~~the steps of~~:

(a) providing a process description comprising at least one governing equation;

(b) obtaining a characterization of a flow of a material ~~using~~ based, at least in part, on the process description using one or more processors;

(c) obtaining a morphological characterization of the material ~~using~~ based, at least in part, on the characterization of the flow of the material using the one or more processors;

(d) predicting a value of a property of the material ~~using~~ based, at least in part, on the morphological characterization using the one or more processors, wherein the value of a property of the material is used in the process description in step (b) to characterize flow;

(e) predicting a value of a property of a product using the morphological characterization, wherein the product is made from the processed material; and

(f) performing a structural analysis of the product using the predicted value of the

property of the product.

46. (Original) The method of claim 45, wherein step (e) comprises creating a structural analysis constitutive model.

47. (Original) The method of claim 45, wherein step (e) comprises predicting a response of the part to a load.

48. (Original) The method of claim 45, wherein step (e) comprises predicting warpage of the part.

49. (Original) The method of claim 45, wherein step (e) comprises predicting at least one member of the group consisting of warpage, shrinkage, crack propagation, creep, wear, lifetime, and failure.

50.-52. (Canceled)

53. (Previously Presented) An apparatus for predicting a property of processed material, the apparatus comprising:

(a) a memory that stores code defining a set of instructions; and

(b) a processor that executes the instructions thereby to:

(i) obtain a characterization of flow of a material using a process description comprising at least one governing equation;

(ii) obtain a morphological characterization of the material using the characterization of flow of the material, wherein step (ii) comprises obtaining the morphological characterization using a description of crystallization kinetics of the material, wherein the description of crystallization kinetics of the material comprises an expression for nucleation rate, the expression

comprising a quiescent conditions term and a flow-induced free energy change term; and

(iii) predict a value of a property of the material using the morphological characterization, wherein step (iii) comprises predicting a viscosity that is used in the process description in step (i) to characterize flow.

54. (Currently Amended) A method for predicting a value of a property of processed material, the method comprising ~~the steps of~~:

(a) providing a process description comprising at least one governing equation;

(b) obtaining a characterization of a flow of a material ~~using~~ based, at least in part, on the process description using one or more processors;

(c) providing a two-phase description of the material, wherein the description is based in part on the characterization of the flow of the material;

(d) obtaining a morphological characterization of the material ~~using~~ based, at least in part, on the two-phase description using the one or more processors, wherein step (d) comprises obtaining the morphological characterization using a description of crystallization kinetics of the material, wherein the description of a crystallization kinetics of the material comprises an expression for nucleation rate, the expression comprising a quiescent conditions term and a flow-induced free energy change term; and

(e) predicting a value of a property of the material ~~using~~ based, at least in part, on the morphological characterization using the one or more processors, wherein step (e) comprises predicting a viscosity that is used in the process description in step (b) to characterize flow.

55. (Original) The method of claim 54, wherein the material undergoes a change of phase during processing.

56. (Original) The method of claim 54, wherein the two-phase description comprises an amorphous phase model and a semi-crystalline phase model.

57-67. (Canceled)

68. (Original) The method of claim 1, wherein step (d) comprises predicting material property values at a plurality of locations within a part made from the processed material.

69. (Original) The method of claim 1, wherein step (d) comprises predicting material property values of a part having an arbitrary geometry, where the part is made from the processed material.

70. (Original) The method of claim 3, wherein the process description comprises a representation of at least one member of the group consisting of a profile extrusion process, a blow film extrusion process, and a film extrusion process.

71. (Currently Amended) The method of claim 45, wherein step ~~(e)~~ (f) comprises predicting a response of the ~~part~~ product to a thermal load.

72. (Previously Presented) The method of claim 45, wherein the process description comprises a representation of an injection molding process.

73. (Previously Presented) The method of claim 45, wherein the process description comprises a representation of at least one member of the group consisting of an extrusion process, a blow molding process, a vacuum forming process, a spinning process, and a curing process.

74. (Previously Presented) The method of claim 54, wherein step (e) comprises predicting at least one of an elastic modulus of the material, a complex modulus of the material, clarity,

opaqueness, surface gloss, color variation, dynamic viscosity, birefringence, and refractive index.